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L13: Entry 8 of 51 File: DWPI Jul 31, 2002

DERWENT-ACC-NO: 2002-604575
DERWENT-WEEK: 200314

TITLE: Molding of polymer composite material, useful in e.g. aircraft, cars and sports goods, containing polyester fiber magnetically oriented in polymer material

PATENT-ASSIGNEE:

ASSIGNEE	CODE
FUJI POLYMATECH CO LTD	FUJIN

PRIORITY-DATA: 2000JP-0346915 (November 14, 2000)

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PATENT-FAMILY:

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APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
JP2002212310A	April 16, 2001	2001JP-0117148	

INT-CL (IPC): B29 C 70/10; B29 K 105:08; C08 J 5/04; C08 L 101:00

ABSTRACTED-PUB-NO: JP2002212310A
BASIC-ABSTRACT:

NOVELTY - A molding of polymer composite material contains polyester fiber oriented in polymer material.

DETAILED DESCRIPTION - A molding of a polymer composite material contains a polyester fiber(s) oriented in a polymer material.

An INDEPENDENT CLAIM is also included for preparation of the molding comprising applying a magnetic field to a polymer composition in which a polyester fiber is oriented in a polymer material so as to magnetize the fiber and thereby make oriented in a specified direction and hardening or solidifying the composition into a desired shape.

USE - Widely useful in space applications, aircraft, cars, electric appliances and sports and leisure goods.

ADVANTAGE - The molding has high performance with respect to mechanical properties, such as elastic modulus and strength, thermal properties, such as thermal expansion coefficient and thermal conductivity, and anisotropic functions, such as optical

and electric properties.

CHOSEN-DRAWING: Dwg.0/4

TITLE-TERMS: MOULD POLYMER COMPOSITE MATERIAL USEFUL AIRCRAFT CAR SPORTS GOODS CONTAIN POLYESTER MAGNETIC ORIENT POLYMER MATERIAL

DERWENT-CLASS: A23 A86 A95 F01

CPI-CODES: A08-R08A; A09-A04; A11-B02B; A12-S; A12-S08C; F01-D04; F03-C; F03-D;

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CPI Secondary Accession Numbers: C2002-171067

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* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the polymer composite Plastic solid with which functional fiber was blended into polymeric materials, and was compound-ized, and its manufacture approach. More specifically, polyester fiber is related with the polymer composite Plastic solid by which orientation was carried out in the fixed direction in polymeric materials, and its manufacture approach as functional plastic fiber.
[0002]
[Description of the Prior Art] Conventionally, the polymer composite Plastic solid with which functional fiber, such as a glass fiber, a carbon fiber, a metal fiber, and an aramid fiber, was blended and compound-ized by the polymeric materials as a matrix is known widely. For example, fiber strengthening resin, fiber reinforced rubber, etc. which raised functionality, such as an elastic modulus and reinforcement, are known, and it is broadly put in practical use as shaping components, such as space, an aircraft, an automobile, an electric product, and a sport, leisure goods.
[0003] And polyester fiber is known as functional plastic fiber which has the function which was excellent in versatility, such as a rate of high elasticity, high intensity, thermal resistance, and low specific gravity, and the polymer composite Plastic solid which distributed combination of the polyester fiber was carried out at random, and was compound-ized is realized in the macromolecule constituent.
[0004] On the other hand, in the latest complicated mechanism element etc., it is anxious for implementation of the new polymer composite Plastic solid which has anisotropy functions, such as thermal properties, such as

mechanical properties, such as an elastic modulus and reinforcement, a coefficient of thermal expansion, and thermal conductivity, optical property, and an electrical property.

[0005] It is realized as the manufacture approach of a polymer composite Plastic solid of the approach to which the orientation of the fiber in a macromolecule constituent compound-ized is made carrying out in the fixed direction having been learned, having made the orientation of a carbon fiber, graphitized-carbon fiber or a glass fiber, and the aramid fiber carrying out in the fixed direction, and having made the anisotropy function discovering using the ** place where the polymeric materials of a matrix do not become thin flowing space at the time of fabrication as an approach of manufacturing the polymer composite Plastic solid which has these anisotropy functions.

[0006] Moreover, by impressing a magnetic field for the carbon fiber in a macromolecule constituent, orientation is made to carry out in the fixed direction, and the manufacture approach of a polymer composite Plastic solid of having made the anisotropy function discovering is learned.

[0007]

[Problem(s) to be Solved by the Invention] However, since distributed combination of the polyester fiber was carried out at random, without carrying out orientation in the fixed direction in a macromolecule constituent, the polymer composite Plastic solid using the above-mentioned conventional polyester fiber as functional plastic fiber was not a polymer composite Plastic solid which functionality is discovered isotropic and has an anisotropy function. That is, in the polymer composite Plastic solid using polyester fiber as functional plastic fiber, the highly efficient polymer composite Plastic solid which has an anisotropy function was not yet realized.

[0008] Therefore, it was expected by making the orientation of the polyester fiber blended into polymeric materials carry out in the fixed direction of arbitration that the highly efficient polymer composite Plastic solid which has an anisotropy function would be realized.

[0009] However, in the manufacture approach of the polymer composite Plastic solid to which the orientation of the fiber compound-ized using the ** place where the above-mentioned conventional polymeric materials do not become thin flowing space, or electric field is made to carry out in the fixed direction, there was much constraint on a process condition or a facility, and there was a problem that the degree of freedom on a design was narrow. Moreover, in the weld part of the matrix with which the flowing macromolecule constituent collides etc., since orientation of the fiber

compound-ized was not necessarily carried out in the fixed direction, there was a problem that it was difficult to make an anisotropy function fully discover. Therefore, the manufacture approach of a polymer composite Plastic solid of having used the ** place where the above-mentioned conventional polymeric materials do not become thin flowing space, or electric field was not the manufacture approach practical as the manufacture approach of a highly efficient polymer composite Plastic solid of having an anisotropy function.

[0010] Moreover, although it was known as mentioned above about the manufacture approach of the polymer composite Plastic solid to which the magnetic field orientation of the carbon fiber as an inorganic fiber was made to carry out in the fixed direction, the manufacture approach of the polymer composite Plastic solid to which the magnetic field orientation of the plastic fiber was made to carry out in the fixed direction is not yet reported. For example, by considering as the report to which magnetic field orientation of the plastic fiber was carried out, and impressing a magnetic field, where ultra-high-molecular-weight-polyethylene fiber is distributed in water and the solution of ethanol Although there is a report (14 47 for example, Polymer Preprint, Japan, Vol. No. 4075 (1998)) to which orientation of the polyethylene fiber was perpendicularly carried out to the direction of a magnetic field The one direction of arbitration was not able to be made to carry out orientation of the polyethylene fiber as plastic fiber also in this report. That is, the polyethylene fiber was not the thing which orientation will be carried out to the direction of line of magnetic force in the perpendicular direction of an indeterminate, i.e., the direction within the vertical plane over line of magnetic force, and the one direction of arbitration was made to carry out orientation. Moreover, since the melting point is about 130 degrees C, a polyethylene fiber has the fault that the thermal resistance of the polymer composite Plastic solid acquired is low. About the approach to which the orientation of the polyester fiber as plastic fiber is made to carry out in the fixed direction furthermore, it is not indicated at all.

[0011] Therefore, although it was expected that the highly efficient polymer composite Plastic solid which has an anisotropy function by making the orientation of the polyester fiber as plastic fiber carry out in the fixed direction of arbitration in a macromolecule constituent would be realized, since such a highly efficient polymer composite Plastic solid and its practical manufacture approach are not indicated at all, they cannot be realized.

[0012] This invention is made in view of the above-mentioned trouble, and

the purpose is in offering the highly efficient polymer composite Plastic solid which has an anisotropy function, and its practical manufacture approach by making the orientation of the polyester fiber as functional plastic fiber which is blended into polymeric materials and is compound-ized carry out in the fixed direction of arbitration.

[0013]

[Means for Solving the Problem] In order to solve the above-mentioned problem, this invention persons reached a header and this invention in the practical manufacture approach of a highly efficient polymer composite Plastic solid that the polymer composite Plastic solid with which orientation of the polyester fiber was carried out in the fixed direction of arbitration in polymeric materials has excelling in anisotropy functions, such as a mechanical property, a thermal property, optical property, and an electrical property, and its anisotropy function.

[0014] That is, polyester fiber is the polymer composite Plastic solid blended into polymeric materials, and invention according to claim 1 is characterized by carrying out orientation of said polyester fiber in the fixed direction in polymeric materials.

[0015] Invention according to claim 2 is characterized by being aromatic polyester fiber in invention according to claim 1. Invention according to claim 3 is characterized by being all aromatic polyester fiber to which aromatic polyester fiber makes the configuration unit originating in aromatic series dicarboxylic acid, and the configuration unit originating in aromatic series diol the main configuration unit in invention according to claim 2.

[0016] Invention according to claim 4 is characterized by being all the aromatic polyester fiber to which aromatic polyester fiber makes the configuration unit originating in aromatic series hydroxycarboxylic acid the main configuration unit, or all aromatic polyester fiber that makes the configuration unit originating in aromatic series dicarboxylic acid, the configuration unit originating in aromatic series diol, and the configuration unit that originates aromatic series hydroxycarboxylic acid the main configuration unit in invention according to claim 2.

[0017] Invention according to claim 5 is characterized by the fiber length of polyester fiber being 10mm or less in invention given in either of claim 1 to claims 4. After invention according to claim 6 making the macromolecule constituent with which polyester fiber was blended into polymeric materials magnetize polyester fiber and making it carry out orientation in the fixed direction to it by impressing a magnetic field, it is characterized by making it

harden or solidify and fabricating a macromolecule constituent in a predetermined configuration.

[0018] Invention according to claim 7 is characterized by anisotropy diamagnetic susceptibility chia of polyester fiber being 1x10 to eight or more in invention of claim 6. Invention according to claim 8 is characterized by polyester fiber being aromatic polyester fiber in invention according to claim 6 or 7.

[0019] Invention according to claim 9 is characterized by being all aromatic polyester fiber to which aromatic polyester fiber makes the configuration unit originating in aromatic series dicarboxylic acid, and the configuration unit originating in aromatic series diol the main configuration unit in invention according to claim 8.

[0020] Invention according to claim 10 is characterized by being all the aromatic polyester fiber to which aromatic polyester fiber makes the configuration unit originating in aromatic series hydroxycarboxylic acid the main configuration unit, or all aromatic polyester fiber that makes the configuration unit originating in aromatic series dicarboxylic acid, the configuration unit originating in aromatic series diol, and the configuration unit that originates aromatic series hydroxycarboxylic acid the main configuration unit in invention according to claim 8.

[0021] Invention according to claim 11 is characterized by the fiber length of polyester fiber being 10mm or less in invention given in either of claim 6 to claims 10.

[0022]

[Embodiment of the Invention] The polyester fiber as functional plastic fiber is the polymer composite Plastic solid blended into polymeric materials, and the polymer composite Plastic solid of this invention is characterized by carrying out orientation of said polyester fiber in the fixed direction in polymeric materials.

[0023] <Polyester fiber> The polyester fiber used as functional plastic fiber is explained first.

[0024] Especially polyester fiber is not limited and well-known polyester fiber can be used for it. Specifically, aromatic polyester fiber, such as others, polyethylene terephthalate and polybutylene terephthalate, and polyethylenenaphthalate, liquid crystallinity polyester fiber, etc. are contained.

[polyester fiber / aliphatic series]

[0025] It is desirable to use all the aromatic polyester fiber called polyarylate fiber also in these. Generally, all aromatic polyester fiber can be excellent in

an elastic modulus, reinforcement, ductility, thermal resistance, weatherability, etc., and can raise functionality, such as a mechanical property of the polymer composite Plastic solid acquired, and a thermal property, by leaps and bounds.

[0026] As such all aromatic polyester fiber What makes the repeat configuration unit originating in (i) aromatic series dicarboxylic acid, and the configuration unit originating in aromatic series diol the main configuration unit although it does not limit especially, (ii) What makes the configuration unit originating in aromatic series hydroxycarboxylic acid the main configuration unit, (iii) What makes the configuration unit originating in aromatic series dicarboxylic acid, the configuration unit originating in aromatic series diol, and the configuration unit originating in aromatic series hydroxycarboxylic acid the main configuration unit is illustrated. In addition, especially about all the illustrated aromatic polyester fiber, it is not limited to the combination of the configuration unit, and what makes the configuration unit which originates in aromatic series hydroxycarboxylic acid of a different kind or of the same kind the main configuration unit is included.

[0027] Especially as a configuration unit originating in aromatic series dicarboxylic acid, although not limited, the configuration unit originating in isophthalic acid, a terephthalic acid, naphthalene dicarboxylic acid, diphenyl dicarboxylic acid, diphenyl ether dicarboxylic acid, difenoxicarboxylic acid, diphenylmethane dicarboxylic acid, diphenyl ketone dicarboxylic acid, diphenyl sulfide dicarboxylic acid, diphenylsulfone dicarboxylic acid, etc. is mentioned, for example.

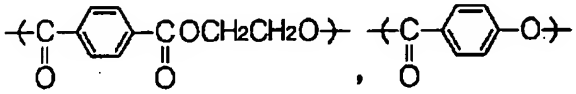
[0028] Especially as a configuration unit originating in aromatic series diol, although not limited, the configuration unit originating in a - dihydroxy-diphenyl thioether, and bisphenol A, 4, and 4'-dihydroxy-diphenyl ether, 4, and 4 '2, 2'-(4 4'-dihydroxy - 3, 5, 3', 5'-tetrabromo diphenyl) propane etc. is mentioned, for example.

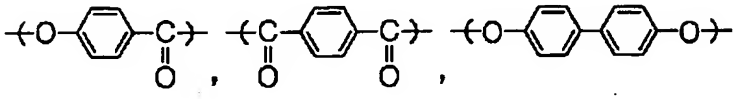
[0029] Especially as a configuration unit originating in aromatic series hydroxycarboxylic acid, although not limited, the configuration unit originating in para hydroxybenzoic acid, a 6-hydroxy-2-naphthoic acid, etc. is mentioned, for example.

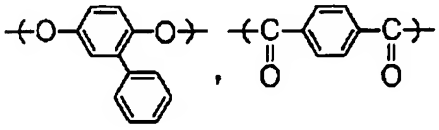
[0030] Although all the aromatic polyester fiber that the combination of a configuration unit shows to following the (1) - (11) is mentioned as all concrete aromatic polyester fiber, it is not limited to especially these.

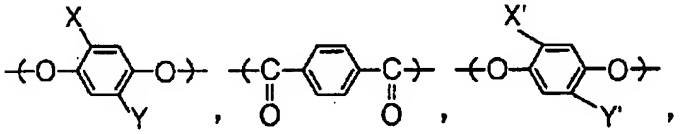
[0031]

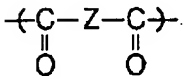
[Formula 1]

(1) 

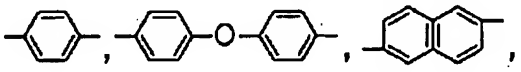
(2) 

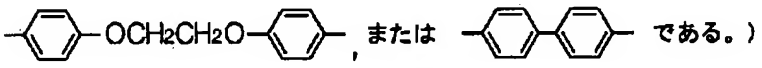
(3) 

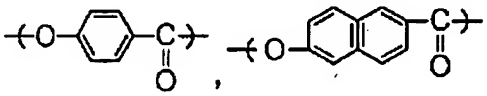
(4) 

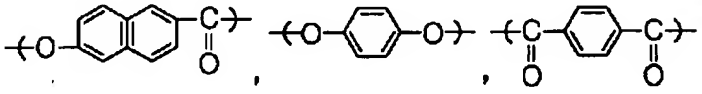


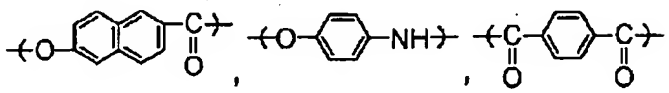
(ここでX，X'およびY，Y'はH，Cl，Br，又はCH3であり、Zは

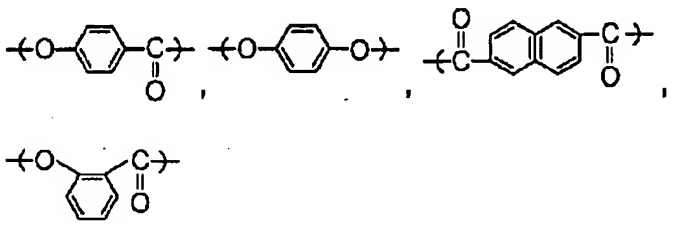


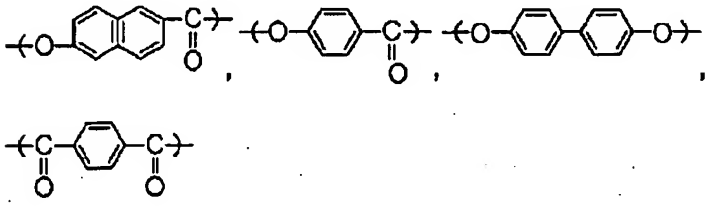


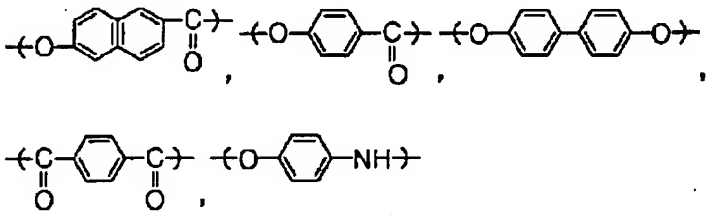
(5) 

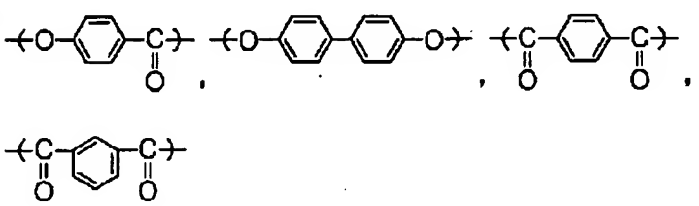
(6) 

(7) 

(8) 

(9) 

(10) 

(11) 

As such all aromatic polyester fiber, BEKUTORAN (trade name) by Kuraray Co., Ltd. which makes the above (5) the main configuration unit is marketed, for example, and it can obtain easily. And since these fiber is excellent about non-absorptivity, abrasion resistance, and impact absorptivity besides the above-mentioned property, it can manufacture the highly efficient polymer composite Plastic solid which has various functionality taking advantage of these properties.

[0032] In addition, as for the ring in each above-mentioned configuration unit, the part may be embellished and/or permuted by substituents, such as a halogen radical, an alkyl group, an alkoxy group, hydroxyl, a cyano group, an acetyl group, a nitro group, and an amino group.

[0033] Moreover, all aromatic polyester fiber may be transposed to the configuration unit to which the part originates in other aromatic series

dicarboxylic acid, aromatic series diols, or aromatic series hydroxycarboxylic acid mentioned above. Or all aromatic polyester fiber may be transposed to the configuration unit to which the part originates in alicycle group dicarboxylic acid, such as aliphatic series dicarboxylic acid, such as a succinic acid, an adipic acid, and a sebacic acid, and cyclohexane dicarboxylic acid, tetralin dicarboxylic acid, decalin dicarboxylic acid, aliphatic series or alicycle group diol, aliphatic series, or alicycle group hydroxycarboxylic acid.

[0034] Furthermore, all aromatic polyester fiber is the purposes which improve functionality, such as thermal resistance and fabrication nature, and the part may be transposed to a polymer with well-known polycarbonate, polybutylene terephthalate, polyethylenenaphthalate, polyester system elastomer, polystyrene system polymer, acrylic polymer, polyamide system polymer, etc.

[0035] It may not be limited especially about the cross-section configuration of polyester fiber, and you may be cross-section configurations, such as the shape of the shape of a whisker, and pulp. Moreover, it is applicable even if it is the bicomponent fiber which has the sheath-core structure which consists of polyester fiber and other fiber.

[0036] Although not limited especially about the diameter of polyester fiber, when the productivity of fiber, combination to handling and polymeric materials, etc. are taken into consideration, the diameter of desirable fiber is 0.1-30 micrometers practical.

[0037] Although it does not limit especially about the fiber length of polyester fiber, it is 10mm or less preferably, and is 2mm or less still more preferably 5mm or less more preferably. In order to raise further the functionality of the polymer composite Plastic solid which is made to discover the anisotropy function of polyester fiber and is acquired, generally the one where the aspect ratio (fiber length of fiber: diameter) of fiber is larger is desirable, but if the fiber length of polyester fiber becomes longer than 10mm, since it will be hard coming to distribute to homogeneity in polymeric materials, and viscosity will rise and a moldability will get worse, it is not desirable. Furthermore, fiber becomes entangled, so that fiber length is long, and it becomes that it is hard to make the orientation of the polyester fiber carry out in the fixed direction. In addition, although especially the minimum of the fiber length of polyester fiber is not limited and changes with fiber diameters, it is desirable that it is 10 micrometers or more, and it is 50 micrometers or more more preferably. Since the anisotropy function of the polymer composite Plastic solid acquired becomes an aspect ratio becomes less than 100 and is hard to be discovered

even if it is the case where the diameter of fiber is 0.1 micrometers as the fiber length of polyester fiber is less than 10 micrometers, it is not desirable.
[0038] As for anisotropy diamagnetic susceptibility chia (system of CGS units) of polyester fiber, it is desirable that it is 1x10 to eight or more. If anisotropy diamagnetic susceptibility chia is smaller than 1x10-8, it will become difficult to make the magnetic field orientation of the polyester fiber carry out in the fixed direction. More desirable anisotropy diamagnetic susceptibility chia is 1x10 to seven or more still more preferably 5x10 to eight or more. It becomes easy to carry out magnetic field orientation of the polyester fiber to altitude, so that anisotropy diamagnetic susceptibility chia of polyester fiber is large. In addition, anisotropy diamagnetic susceptibility chia of polyester fiber is presumed that 1x10-5 to 1x10 to about six are an upper limit.
[0039] Here, anisotropy diamagnetic susceptibility chia is a value (system of CGS units) which shows the anisotropy of the diamagnetic susceptibility which deducted vertical magnetic-susceptibility chi** from magnetic-susceptibility chi//of the fiber shaft orientations of fiber to the fiber axis produced by impressing a magnetic field from the exterior. The more orientation of the fiber axis is carried out in parallel along with line of magnetic force under a magnetic field ambient atmosphere and the absolute value of this anisotropy diamagnetic susceptibility chia becomes large, the more the orientation of the fiber this anisotropy diamagnetic susceptibility chia indicates a forward value to be, for example, the polyester fiber etc., can be made to carry out in the fixed direction to altitude by impressing a magnetic field. On the other hand, if anisotropy diamagnetic susceptibility chia uses the fiber which shows a negative value, for example, the above-mentioned conventional polyethylene fiber etc., a magnetic field will act so that a fiber axis may become perpendicular to line of magnetic force, orientation of the fiber will be carried out to the direction of line of magnetic force in the perpendicular direction of an indeterminate, i.e., the direction of the vertical plane over line of magnetic force, and orientation cannot be made to carry out in the fixed direction of arbitration. In addition, anisotropy diamagnetic susceptibility chia can be measured by well-known approaches, such as a magnetic-anisotropy torque meter, an oscillating-type magnetometer, SQUID (superconducting quantum interference device), and the suspension method.
[0040] <Polymeric materials> The polymeric materials as a matrix are explained below. Especially as polymeric materials, it is not limited and

thermoplastics, thermoplastic elastomer, various hardenability resin, bridge formation rubber, its prototype, etc. can be used suitably, corresponding to military requirements, such as the mechanical property of the polymer composite Plastic solid made into the purpose, a thermal property, optical property, an electrical property, endurance, and dependability.

[0041] As concrete thermoplastics, ethylene-alpha olefin copolymers, such as polyethylene, polypropylene, and ethylene propylene rubber, The poly methyl pentene, a polyvinyl chloride, a polyvinylidene chloride, polyvinyl acetate, An ethylene-vinylacetate copolymer, polyvinyl alcohol, a polyvinyl acetal, Fluororesins, such as polyvinylidene fluoride and polytetrafluoroethylene, Polyethylene terephthalate, polybutylene terephthalate, polyethylenenaphthalate, Polystyrene, a polyacrylonitrile, a styrene acrylonitrile copolymer, ABS plastics, polyphenylene ether and denaturation PPE resin, aliphatic series, and aromatic polyamide Polymethacrylic acid ester, such as polyimide, polyamidoimide, polymethacrylic acid, and its methyl ester Polyacrylic acid, a polycarbonate, a polyphenylene sulfide, the poly ape phone, polyether sulphone, polyether nitril, a polyether ketone, the poly ketone, a liquid crystal polymer, silicone resin, an ionomer, etc. are mentioned.

[0042] As concrete thermoplastic elastomer, a styrene-butadiene or a styrene-isoprene block copolymer and its hydrogenation polymer, a styrene thermoplastic elastomer, thermoplastic elastomer olefin, vinyl chloride system thermoplastic elastomer, thermoplastic elastomer polyester, polyurethane system thermoplastic elastomer, thermoplastic elastomer polyamide, etc. are mentioned.

[0043] As concrete hardenability resin, an epoxy resin, polyimide resin, acrylic resin, a bismaleimide resin, benz-cyclo-butene resin, phenol resin, an unsaturated polyester resin, diallyl phthalate resin, silicone resin, urethane resin, polyimide silicone resin, heat-curing mold polyphenylene ether, denaturation PPE resin, etc. are mentioned.

[0044] As concrete bridge formation rubber and its prototype, natural rubber, butadiene rubber, polyisoprene rubber, styrene butadiene rubber, nitrile rubber, hydrogenation nitrile rubber, chloroprene rubber, ethylene-propylene rubber, chlorinated polyethylene, chlorosulfonated polyethylene, isobutylene isoprene rubber and halogenation isobutylene isoprene rubber, a fluororubber, polyurethane rubber, silicone rubber, liquid rubber, etc. are mentioned.

[0045] It is desirable from a viewpoint of the temperature characteristics, such as thermal resistance, or electric dependability to use at least one sort of

polymeric materials chosen from the group which consists of an epoxy resin, an unsaturated polyester resin, phenol resin, acrylic resin, urethane resin, polyimide resin, silicone resin, and liquid rubber also in these polymeric materials. In addition, if these polymeric materials are used, in case polyester fiber is mixed, orientation control of the polyester fiber which is the liquid of hypoviscosity, or is blended with polymeric materials since it can hypoviscosity-ize at the time of heating melting will become easy. More specifically, it is suitable to use the polymeric materials of hypoviscosity in macromolecule precursors and melting conditions, such as a liquefied epoxy resin and a liquefied unsaturated polyester resin, and liquid rubber.

[0046] Moreover, a kind may be independently used for these polymeric materials, or may be used for them, combining two or more sorts suitably, and even if they use the polymer alloy which consists of two or more polymeric materials chosen from these polymeric materials further, they do not interfere. In addition, especially about the bridge formation approach of hardenability resin or bridge formation rubber, it is not limited but the well-known bridge formation approaches, such as a heat-curing method, a photo-curing method, the moisture hardening method, a radiation, or an electron-beam-irradiation method, can be adopted.

[0047] A <polymer composite Plastic solid> polymer composite Plastic solid is characterized by carrying out orientation of the polyester fiber as functional plastic fiber mentioned above in the fixed direction in polymeric materials. Thus, by carrying out orientation of the polyester fiber in the fixed direction in polymeric materials, highly efficient nature with various elastics modulus of a direction, reinforcement, etc. can be demonstrated in the fiber length as functional plastic fiber, and the highly efficient polymer composite Plastic solid which has an anisotropy function can be realized now.

[0048] It becomes possible to specifically raise the reinforcement of a polymer composite Plastic solid by using the high **** breaking strength of polyester fiber, to raise the elasticity of the specific direction of a polymer composite Plastic solid by using the high elastic modulus of the fiber shaft orientations of polyester fiber, or to make small a coefficient of thermal expansion, a dimensional change, etc. of the specific direction of a polymer composite Plastic solid by using the low-fever expansibility of the fiber shaft orientations of polyester fiber etc.

[0049] Especially about the configuration of a polymer composite Plastic solid, it is not limited, a well-known configuration can be adopted, for example, configurations, such as the shape of the shape of the shape of a cube,

a globular shape, cylindrical, tabular, and a film, a cylinder, and a tube, are mentioned. In addition, as for a polymer composite Plastic solid, orientation of the polyester fiber of only the partial part of a Plastic solid may be carried out in the fixed direction.

[0050] And a polymer composite Plastic solid is applicable to the Plastic solid of all applications with which anisotropy functions, such as thermal properties, such as mechanical properties, such as an elastic modulus and reinforcement, a coefficient of thermal expansion, and thermal conductivity, an electrical property, and optical property, are demanded, for example, it can apply to a machine part, a mechanism element, autoparts, an electric product, etc., or it can be applied to components and variant Plastic solids, such as housing of an electric product or an automobile product, a substrate, and a conduction belt.

[0051] After the manufacture approach of the polymer composite Plastic solid of <manufacture approach> this invention making the macromolecule constituent with which the polyester fiber as functional plastic fiber was blended into polymeric materials magnetize polyester fiber and making it carry out orientation in the fixed direction to it by impressing a magnetic field, it is characterized by making it harden or solidify and fabricating a macromolecule constituent in a predetermined configuration.

[0052] (Adjustment of a giant-molecule constituent) A giant-molecule constituent can be obtained by blending into the polymeric materials which mentioned above the polyester fiber mentioned above using well-known mixing / kneading equipments, such as a blender, a mixer, a roll, and an extruder. In addition, in case mixed distribution is carried out, it is desirable by decompressing or pressurizing to add the process which removes the mixed air bubbles.

[0053] Although especially the loadings of the polyester fiber blended into polymeric materials are suitably determined by the military requirement of the final product which it is not limited but is made into the purpose etc., it is desirable that it is 0.01 - 50 weight section to the polymeric-materials 100 weight section. Improvement in the anisotropy function of the polymer composite Plastic solid acquired is attained so that there are many loadings of polyester fiber, but if the loadings of polyester fiber exceed 50 weight sections, since the viscosity of a macromolecule constituent increases, a fluidity is spoiled and orientation control of polyester fiber becomes difficult, it is not desirable. Moreover, if there are few loadings of polyester fiber than the 0.01 weight section, since the improvement effectiveness of the

functionality of the polymer composite Plastic solid acquired becomes small, it is not desirable. The loadings of more desirable polyester fiber are 0.02 - 30 weight section to the polymeric-materials 100 weight section, and are 0.05 - 20 weight section still more preferably.

[0054] Moreover, a macromolecule constituent may be intermingled in the carbon fiber which covered metals, such as organic fiber, such as a small amount of aramid fiber, an aliphatic series polyamide fiber, polybenzazole fiber, polyimide fiber, polyphenylene sulfide fiber, phenol fiber, polyolefine fiber, and Vinylon fiber, a natural fiber, a carbon fiber, a metal fiber, ceramic fiber, and a bicomponent fiber which compounded these fiber, nickel, on the front face as fiber other than the above-mentioned polyester fiber, organic fiber, those little textile fabrics, nonwoven fabrics, etc. By making these little fiber or textile fabrics, nonwoven fabrics, etc. intermingled, the various functionality of the polymer composite Plastic solid acquired can be raised. Furthermore, even if a macromolecule constituent uses together a small amount of additives, such as other bulking agents and plasticizers, a cross linking agent, a coloring agent, a stabilizer, and a solvent, if needed, it does not interfere.

[0055] In addition, in order to raise wettability and an adhesive property with polymeric materials, it is desirable beforehand cleaning and to carry out washing processing or to perform activation, such as UV irradiation processing, corona discharge treatment, plasma treatment, flame treatment, or an ion implantation, for the front face of polyester fiber. Moreover, it is desirable to process the front face of polyester fiber by the usual coupling agents, resorcinol formalin latexes, etc., such as a silane system, and a titanium system, an aluminum system, in addition to such surface preparation. Consequently, it becomes that it is easy to carry out distributed mixing of still a lot of polyester fiber into polymeric materials.

[0056] Moreover, by adding an volatile organic solvent and an volatile reaction plasticizer, making a macromolecule constituent hypoviscosity-ize, increasing the loadings of polyester fiber or making small the specific gravity difference of polyester fiber and polymeric materials, sedimentation of the polyester fiber in the inside of a macromolecule constituent can be prevented, and orientation can also be promoted.

[0057] (Shaping of a polymer composite Plastic solid) A polymer composite Plastic solid hardens or solidifies the macromolecule constituent mentioned above using well-known approaches, such as various hardening reactions and cooling processing, and is acquired by fabricating in a predetermined

configuration.
[0058] Especially about the shaping approach of a polymer composite Plastic solid, it is not limited and an extrusion method, an injection-molding method, compression forming, the transfer-molding method, a blow molding method, a vacuum-forming method, a rotational casting method, etc. can be applied.
[0059] (Orientation) It is magnetized by impressing a magnetic field from the exterior, and orientation of the polyester fiber in a macromolecule constituent is carried out so that the fiber axis may become parallel to line of magnetic force. Thereby, the orientation of the polyester fiber can be made to be able to carry out in the fixed direction of arbitration, and the highly efficient polymer composite Plastic solid which has anisotropy functions, such as mechanical properties, such as an elastic modulus and reinforcement, a thermal property, optical property, and an electrical property, can be manufactured simple taking advantage of anisotropy properties, such as the high elasticity of the fiber shaft orientations of polyester fiber, and low-fever expansibility.
[0060] In case a tabular polymer composite Plastic solid is more specifically fabricated, when making the orientation of the polyester fiber carry out in the thickness direction, the orientation of the polyester fiber can be made to carry out in the thickness direction by installing so that N pole and the south pole of a permanent magnet or an electromagnet may be countered in the thickness direction, and impressing a magnetic field so that the sense of line of magnetic force may be suitable in the thickness direction. And the polymer composite Plastic solid with which orientation of the polyester fiber was carried out in the thickness direction can be acquired by hardening or solidifying a macromolecule constituent in the condition of having made the orientation of the polyester fiber carrying out in the thickness direction.
[0061] On the other hand, in case a tabular polymer composite Plastic solid is fabricated, when making the one direction within a field carry out orientation of the polyester fiber, the one direction within a field can be made to carry out orientation of the polyester fiber by installing so that magnetic N pole and the magnetic south pole may be countered in the perpendicular direction to the thickness direction, and impressing a magnetic field so that the sense of line of magnetic force may turn to the one direction within a field. And the polymer composite Plastic solid with which orientation of the polyester fiber was carried out to the one direction within a field can be acquired by hardening or solidifying a macromolecule constituent in the condition of having made the one direction within a field carrying out orientation of the polyester fiber. In addition, even if it makes N pole, N pole or the magnetic south pole, and the

magnetic south pole counter in the thickness direction, the one direction within a field can be made to carry out orientation of the polyester fiber.
[0062] Unlike the ultra-high-molecular-weight-polyethylene fiber mentioned above, carrying out orientation so that polyester fiber may become parallel [the fiber axis] to line of magnetic force here (a) Although a magnetic field acts so that a fiber axis may become perpendicular to line of magnetic force in order that anisotropy diamagnetic susceptibility chia may show a negative value, a polyethylene fiber polyester fiber -- an anisotropy -- diamagnetic susceptibility -- chi -- a -- forward -- a value -- being shown -- a sake -- line of magnetic force -- receiving -- a fiber axis -- being parallel -- ** -- becoming -- as -- a magnetic field -- acting -- having -- things -- (-- b --) -- a ring -- line of magnetic force -- receiving -- perpendicular -- arranging -- having -- if -- an eddy current -- being generated -- a sake -- In the case of fiber, such as polyester fiber extended and obtained, the high molecular compound which contains a ring in a principal chain so that a ring may become parallel to line of magnetic force If the anisotropy magnetic susceptibility of that a magnetic field acts and the (c) ring is taken into consideration so that a fiber axis may become parallel to line of magnetic force The direction of orientation where as many rings in the polyester fiber by which orientation is carried out as possible become parallel to line of magnetic force is presumed to be what is depended on the most stable reasons in energy.
[0063] Therefore, if aromatic polyester fiber or all aromatic polyester fiber is used as polyester fiber to blend, orientation can be carried out to altitude in a macromolecule constituent so that a fiber axis may become parallel to line of magnetic force, and the polymer composite Plastic solid which has an anisotropy function can be manufactured still simpler.
[0064] Especially as a magnetic field generating means, it is not limited, for example, a permanent magnet, an electromagnet, a coil, etc. are used suitably. Moreover, although especially the flux density showing the magnetic field strength is not limited, it can attain the orientation of practical and effective polyester fiber as it is 0.1-30 teslas. Moreover, in order to make the orientation of the polyester fiber carry out in the fixed direction using very weak anisotropy diamagnetic susceptibility chia of polyester fiber, it is desirable that it is stronger flux density, and 0.5 teslas or more of more desirable flux density are two teslas or more still more preferably.
[0065] In addition, line of magnetic force may not necessarily be a straight line-like, and whether it is the shape of a curve, and a rectangle or it is more than a 2-way, it is not cared about. Moreover, you may be the configuration

that some macromolecule constituents are arranged under a magnetic field ambient atmosphere. Moreover, it is possible to make the orientation of the polyester fiber in a macromolecule constituent carry out in the fixed direction of arbitration also with the magnet which did not need to be made to not necessarily counter both sides about a magnet, and has been arranged only in one side. Furthermore, the orientation of the polyester fiber in a macromolecule constituent can also be promoted by adding vibration to a macromolecule constituent or reversing the direction of line of magnetic force.

[0066] <Application> drawing 1 (a) - (d) and drawing 2 (a) The application of the manufacture approach of the polymer composite Plastic solid of this invention is shown in - (d).

[0067] It is filled up with macromolecule constituent 13a in shaping crevice 11a of metal mold 11, and under the magnetic field ambient atmosphere which N pole and the south pole of a magnet 12 as a magnetic field generating means counter, after carrying out orientation of the polyester fiber 14 in parallel along with line of magnetic force, macromolecule constituent 13a is hardened or solidified, it fabricates in a predetermined configuration, and polymer composite Plastic solid 13 is manufactured. Polymer composite Plastic solid 13 with which orientation of the polyester fiber was carried out by this so that the fiber axis might become parallel to line of magnetic force is acquired easily. In addition, drawing 1 (a) - (d) shows the example of the manufacture approach of polymer composite Plastic solid 13 that orientation of the polyester fiber 14 was carried out in the fixed direction into the field, and drawing 2 (a) - (d) shows the example of the manufacture approach of polymer composite Plastic solid 13 that orientation of the polyester fiber 14 was carried out in the thickness direction.

[0068] The effectiveness demonstrated according to the above operation gestalt is summarized to below, and is indicated.

- The orientation of the polyester fiber was made to carry out in the fixed direction in polymeric materials in the polymer composite Plastic solid with which functional plastic fiber was blended into polymeric materials, and was compound-ized, using polyester fiber as functional plastic fiber. Taking advantage of the property of polyester fiber that this has the function which was excellent in versatility, such as a rate of high elasticity, high intensity, thermal resistance, and low specific gravity, the highly efficient polymer composite Plastic solid which has an anisotropy function can be realized now.

[0069] - After impressing the magnetic field to the macromolecule constituent

with which polyester fiber was blended into polymeric materials and making the orientation of the polyester fiber carry out in the fixed direction to it, the polymer composite Plastic solid was manufactured by making it harden or solidify and fabricating a macromolecule constituent in a predetermined configuration. While being able to make the orientation of the polyester fiber carry out in the fixed direction to altitude as compared with the conventional process to which orientation of the polyester fiber is carried out mechanically by this, the polymer composite Plastic solid which has an anisotropy function can be acquired simply. Moreover, anisotropy diamagnetic susceptibility chia of polyester fiber can acquire still more simply the polymer composite Plastic solid which has an anisotropy function, while the orientation of the polyester fiber can be made to carry out in the fixed direction to altitude and orientation control of polyester fiber becomes easy by impressing a magnetic field as it is 1x10 to eight or more.

[0070] - Aromatic polyester fiber was used as polyester fiber as functional plastic fiber. While being able to carry out orientation to altitude by this using the magnetic field operation over the ring mentioned above so that a fiber axis may become parallel to line of magnetic force, the polymer composite Plastic solid excellent in an elastic modulus, reinforcement, thermal resistance, weatherability, etc. can be acquired further. If all aromatic polyester fiber is used especially, under a magnetic field ambient atmosphere, further, it can be made to be able to blend with altitude and a much more highly efficient polymer composite Plastic solid can be realized.

[0071] - Fiber length of polyester fiber was set to 10mm or less. Thereby, while being able to make homogeneity distribute polyester fiber in polymeric materials, fabrication nature can be made good and orientation control of the polyester fiber in a macromolecule constituent becomes easy.

[0072]

[Example] Although an example and the example of a comparison are given and said operation gestalt is explained still more concretely hereafter, these do not restrict the range of this invention at all.

[0073] (Measurement of anisotropy diamagnetic susceptibility chia) When anisotropy diamagnetic susceptibility chia (system of CGS units) of BEKUTORAN HT by Kuraray Co., Ltd. (diameter of 10 micrometers) which is all aromatic polyester fiber was measured with the magnetic-anisotropy torque meter (Tamagawa, Inc. factory magnetic-anisotropy torque meter), it was 3.6x10-7.

[0074] (Example 1) Vacuum degassing of the polyester fiber ([by Kuraray

Co., Ltd.] all aromatic-polyester fiber BEKUTORAN HT: diameter [of 10 micrometers], die length of 1mm) 2 weight section which degreased the front face by ethanol was mixed and carried out to the unsaturated-polyester-resin (EPO rack G157 by NIPPON SHOKUBAI Co., Ltd.) 100 weight section as polymeric materials, and macromolecule constituent 13a was prepared.

[0075] As shown in drawing 1 (a) - (d), obtained macromolecule constituent 13a Under the magnetic field ambient atmosphere which is the flux density of eight teslas which it is filled up in shaping crevice 11a of the tabular metal mold 11 made from aluminum with which fluororesin coating of the front face was carried out, and N pole and the south pole of a magnet 12 as a magnetic field generating means counter After making the longitudinal direction within a field fully carry out orientation of the polyester fiber, carried out heat hardening, it was made to solidify, and tabular polymer composite Plastic solid 13 was produced. As shown in drawing 1 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out to the one direction within a field.

[0076] Similarly, as shown in drawing 2 (a) - (d), macromolecule constituent 13a Under the magnetic field ambient atmosphere which is the flux density of eight teslas which it is filled up in shaping crevice 11a of the tabular metal mold 11 made from aluminum with which fluororesin coating of the front face was carried out, and N pole and the south pole of a magnet 12 as a magnetic field generating means counter After making the orientation of the polyester fiber fully carry out in the thickness direction, carried out heat hardening, it was made to solidify, and tabular polymer composite Plastic solid 13 was produced. As shown in drawing 2 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out in the thickness direction.

[0077] The result of having measured the bending elastic modulus (JIS K7055) and coefficient of linear expansion (JIS K7197) of each polymer composite Plastic solid 13 which were obtained is shown in Table 1. In addition, measurement of this bending elastic modulus and coefficient of linear expansion was measured using the test piece for evaluation (bending elastic modulus: the thickness of 5mm, 15mm long, the side of 120mm, the coefficient-of-linear-expansion:thickness of 5mm, 5mm long, 5mm wide) which carried out cutting of acquired polymer composite Plastic solid 13, and produced it. Here, measurement of a bending elastic modulus and coefficient of linear expansion measures the test piece for evaluation in the thickness direction of polymer composite Plastic solid 13 used as each base material.

Therefore, in the test piece for evaluation of the direction of orientation which the bending elastic modulus and the coefficient of linear expansion of polymer composite Plastic solid 13 perpendicular to the fiber axis used as the direction which bends the polyester fiber 14 by which orientation was carried out to field inboard in the test piece for evaluation of the direction of orientation shown in drawing 1 (d) of a direction (henceforth an axial perpendicular direction) show to drawing 2 (d), the parallel (henceforth an axial parallel direction) bending elastic modulus and the coefficient of linear expansion of polymer composite Plastic solid 13 will be obtained by the fiber axis.

[0078] (An example 2, example 3) Tabular polymer composite Plastic solid 13 was produced by the same approach as an example 1 except having considered as the loadings which show the loadings of polyester fiber in Table 1, respectively. Like the example 1, as shown in drawing 1 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out to the one direction within a field, and the polyester fiber 14 of one polymer composite Plastic solid 13 was carrying out orientation of the polyester fiber 14 of polymer composite Plastic solid 13 of another side in the thickness direction, as shown in drawing 2 (d).

[0079] The measurement result of the bending elastic modulus and coefficient of linear expansion which were measured like the example 1 is shown in Table 1.

(Example 1 of a comparison) It is filled up only with the unsaturated polyester resin (EPO rack G157 by NIPPON SHOKUBAI Co., Ltd.) as polymeric materials in shaping crevice 11a of the tabular metal mold 11 made from aluminum with which fluororesin coating of the front face was carried out as shown in drawing 1 (a) - (b), carried out heat hardening, it was made to solidify as an object for a comparison, and the tabular polymeric-materials Plastic solid was produced.

[0080] The measurement result of the bending elastic modulus and coefficient of linear expansion which were measured like the example 1 is shown in Table 1. In addition, since polyester fiber is not blended in this example of a comparison, the measurement result of this bending elastic modulus and coefficient of linear expansion measures the bending elastic modulus and coefficient of linear expansion of a polymeric-materials Plastic solid of a direction corresponding to each measurement direction of polymer composite Plastic solid 13 of an example 1.

[0081] (Example 2 of a comparison) Tabular polymer composite Plastic solid 13 was produced by the same approach as an example 2 except having carried

out heat hardening of the macromolecule constituent 13a of an example 2, without impressing a magnetic field, and having solidified it as an object for a comparison. The polyester fiber 14 in acquired polymer composite Plastic solid 13 was distributed at random, as shown in drawing 3 R> 3, and the stacking tendency was not accepted.

[0082] The measurement result of the bending elastic modulus and coefficient of linear expansion which were measured like the example 1 is shown in Table 1. In addition, since orientation of the polyester fiber 14 is not carried out in the fixed direction in this example of a comparison, the measurement result of this bending elastic modulus and coefficient of linear expansion measures the bending elastic modulus and coefficient of linear expansion of a direction corresponding to each measurement direction of polymer composite Plastic solid 13 of an example 1.

[0083]

[Table 1]

	実施例1	実施例2	実施例3	比較例1	比較例2
不飽和ポリエステル樹脂 (重量部)	100	100	100	100	100
ポリエステル繊維 (重量部)	2	4	7	0	4
磁束密度 (テスラ)	8	8	8	0	0
曲げ弾性率 (MPa)					
軸垂直方向	3960	4600	5570	3310	4190
軸平行方向	3510	4020	3950	3310	4190
線膨張係数 (/℃)					
軸垂直方向	21.0×10^{-5}	22.0×10^{-5}	22.0×10^{-5}	14.0×10^{-5}	11.0×10^{-5}
軸平行方向	3.6×10^{-5}	2.0×10^{-5}	1.4×10^{-5}	14.0×10^{-5}	11.0×10^{-5}

(Example 4) After adding and hypoviscosity-izing the hexane 50 weight section as a solvent in the liquefied silicone rubber (GE silicone incorporated company make TSE3070) 100 weight section as polymeric materials, the polyester fiber ([by Kuraray Co., Ltd.] all aromatic-polyester fiber BEKUTORAN HT: diameter [of 10 micrometers], die length of 1mm) 3 weight section which degreased the front face with the methanol and carried out silane coupling agent processing was mixed, and macromolecule constituent 13a was prepared.

[0084] As shown in drawing 1 (a) - (d), obtained macromolecule constituent 13a The thickness of 2mm made from aluminum to which fluororesin coating of the front face was carried out, Under the magnetic field ambient atmosphere which is the flux density of ten teslas which it is filled up in shaping crevice 11a of the tabular metal mold 11 of 40mm long and 120mm wide, and N pole and the south pole of a magnet 12 as a magnetic field

generating means counter After making the longitudinal direction within a field fully carry out orientation of the polyester fiber and volatilizing the hexane of a solvent, carried out heat hardening, it was made to solidify, and tabular polymer composite Plastic solid 13 was produced. As shown in drawing 1 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out to the one direction within a field.
[0085] Similarly, as shown in drawing 2 (a) - (d), macromolecule constituent 13a The thickness of 2mm made from aluminum to which fluororesin coating of the front face was carried out, Under the magnetic field ambient atmosphere which is the flux density of ten teslas which it is filled up in shaping crevice 11a of the tabular metal mold 11 of 40mm long and 120mm wide, and N pole and the south pole of a magnet 12 as a magnetic field generating means counter After making the orientation of the polyester fiber fully carry out in the thickness direction and volatilizing the hexane of a solvent, carried out heat hardening, it was made to solidify, and tabular polymer composite Plastic solid 13 was produced. As shown in drawing 2 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out in the thickness direction.
[0086] When the tensile strength (JIS K6251) of the direction of a field of each acquired polymer composite Plastic solid 13 was measured, the tensile strength of polymer composite Plastic solid 13 of 26kPa(s) and an axial perpendicular direction of the tensile strength of polymer composite Plastic solid 13 of the axial parallel direction of polyester fiber 14 was 18kPa(s).
[0087] (Example 3 of a comparison) Tabular polymer composite Plastic solid 13 was produced by the same approach as an example 4 except having carried out heat hardening of the macromolecule constituent 13a of an example 4 as an object for a comparison, without impressing a magnetic field. The polyester fiber 14 in each acquired polymer composite Plastic solid 13 was distributed at random, as shown in drawing 3 , and the stacking tendency was not accepted.
[0088] When the tensile strength (JISK6251) of acquired polymer composite Plastic solid 13 was measured like the example 4, there was no anisotropy in tensile strength and it was 23kPa.
[0089] (Example 5) Vacuum degassing of the polyester fiber ([by Kuraray Co., Ltd.] all aromatic-polyester fiber BEKUTORAN HT: diameter [of 10 micrometers], die length of 1mm) 2 weight section which degreased the front face by ethanol was mixed and carried out to the epoxy resin (TBby Three Bond Co., Ltd.2280C) 100 weight section as polymeric materials, and

macromolecule constituent 13a was prepared.
[0090] As shown in drawing 1 (a) - (d), obtained macromolecule constituent 13a Under the magnetic field ambient atmosphere which is the flux density of five teslas which it is filled up in shaping crevice 11a of the tabular metal mold 11 made from aluminum with which fluororesin coating of the front face was carried out, and N pole and the south pole of a magnet 12 as a magnetic field generating means counter After making the longitudinal direction within a field fully carry out orientation of the polyester fiber, carried out heat hardening, it was made to solidify, and tabular polymer composite Plastic solid 13 was produced. As shown in drawing 1 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out to the one direction within a field.
[0091] Similarly it was filled up with giant-molecule constituent 13a in shaping crevice 11a of the tabular metal mold 11 made from aluminum with which fluororesin coating of the front face was carried out, and under the magnetic field ambient atmosphere which is the flux density of five teslas which N pole and the south pole of a magnet 12 as a magnetic field generating means counter, after making the orientation of the polyester fiber fully carry out in the thickness direction, carried out heat hardening, it was made to solidify, and tabular polymer composite Plastic solid 13 was produced. As shown in drawing 2 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out in the thickness direction.
[0092] When the coefficient of linear expansion (JIS K7197) of each acquired polymer composite Plastic solid 13 was measured like the example 1, the coefficient of linear expansion of polymer composite Plastic solid 13 of 3.5x10-5/degree C and an axial perpendicular direction of the coefficient of linear expansion of polymer composite Plastic solid 13 of the axial parallel direction of polyester fiber 14 was 25.1x10-5/degree C.
[0093] (Example 4 of a comparison) It is filled up only with the epoxy resin (TBby Three Bond Co., Ltd.2280C) as polymeric materials in shaping crevice 11a of the tabular metal mold 11 made from aluminum with which fluororesin coating of the front face was carried out as shown in drawing 1 (a) - (b), carried out heat hardening, it was made to solidify as an object for a comparison, and the tabular polymeric-materials Plastic solid was produced.
[0094] When the coefficient of linear expansion (JIS K7197) of the acquired polymeric-materials Plastic solid was measured like the example 5, there was no anisotropy in coefficient of linear expansion, and it was 15.4x10-5/degree C. In addition, since polyester fiber is not blended in this example of a

comparison, the measurement result of this bending elastic modulus measures the coefficient of linear expansion of the polymeric-materials Plastic solid of the direction corresponding to each measurement direction of polymer composite Plastic solid 13 of an example 5.

[0095] (Example 5 of a comparison) Tabular polymer composite Plastic solid 13 was produced by the same approach as an example 5 except having carried out heat hardening of the macromolecule constituent 13a of an example 5 as an object for a comparison, without impressing a magnetic field. The polyester fiber 14 in acquired polymer composite Plastic solid 13 was distributed at random, as shown in drawing 3 , and the stacking tendency was not accepted.

[0096] When the coefficient of linear expansion (JISK7197) of acquired polymer composite Plastic solid 13 was measured like the example 5, there was no anisotropy in coefficient of linear expansion, and it was 15.1x10-5/degree C. In addition, since orientation of the polyester fiber 14 is not carried out in the fixed direction in this example of a comparison, the measurement result of this coefficient of linear expansion measures the coefficient of linear expansion of the direction corresponding to each measurement direction of polymer composite Plastic solid 13 of an example 1.

[0097] (Example 6) As polymeric materials, the polyester fiber ([by Kuraray Co., Ltd.] all aromatic-polyester fiber BEKUTORAN HT: diameter [of 10 micrometers], die length of 1mm) 3 weight section was mixed in the unsaturated-polyester-resin (EPO rack G157 by NIPPON SHOKUBAI Co., Ltd.) 100 weight section, and macromolecule constituent 13a was prepared in it.

[0098] As shown in drawing 1 (a) - (c), obtained macromolecule constituent 13a The thickness of 2mm made from aluminum to which fluororesin coating of the front face was carried out, Under the magnetic field ambient atmosphere which is the flux density of ten teslas which it is filled up in shaping crevice 11a of the tabular metal mold 11 of 40mm long and 40mm wide, and N pole and the south pole of a magnet 12 as a magnetic field generating means counter After making the longitudinal direction within a field fully carry out orientation of the polyester fiber, carried out room temperature setting, it was made to solidify, and tabular polymer composite Plastic solid 13 was produced. As shown in drawing 1 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out to the one direction within a field.

[0099] Similarly, as shown in drawing 2 (a) - (c), macromolecule constituent 13a The thickness of 2mm made from aluminum to which fluororesin coating of the front face was carried out, Under the magnetic field ambient atmosphere with a flux density of ten teslas where it is filled up in shaping crevice 11a of the tabular metal mold 11 of 40mm long and 40mm wide, and N pole and the south pole of a magnet 12 as a magnetic field generating means counter perpendicularly to the thickness direction After making the orientation of the polyester fiber fully carry out in the thickness direction, carried out heat hardening, it was made to solidify, and tabular polymer composite Plastic solid 13 was acquired. As shown in drawing 2 (d), orientation of the polyester fiber 14 in acquired polymer composite Plastic solid 13 was carried out in the thickness direction.

[0100] The result of having measured the permeability spectrum of the thickness direction of each acquired polymer composite Plastic solid 13 is shown in drawing 4 . In addition, a permeability spectrum measures the permeability spectrum of the thickness direction of polymer composite Plastic solid 13 with spectrophotometer for ultraviolet and visible region, and, thereby, the permeability spectrum of the axial parallel direction of the polyester fiber 14 of polymer composite Plastic solid 13 and the permeability spectrum of an axial perpendicular direction are obtained.

[0101] (Example 6 of a comparison) Tabular polymer composite Plastic solid 13 was produced by the same approach as an example 6 except having carried out room temperature setting of the macromolecule constituent 13a of an example 6 as an object for a comparison, without impressing a magnetic field. The polyester fiber 14 in acquired polymer composite Plastic solid 13 was distributed at random, as shown in drawing 3 , and the stacking tendency was not accepted.

[0102] The result of having measured the permeability spectrum of the thickness direction of acquired polymer composite Plastic solid 13 like the example 5 is shown in drawing 6.

The polymeric-materials Plastic solid with which the example 1 of a <effectiveness of example> comparison consists only of an unsaturated polyester resin, The conventional polymer composite Plastic solid with which, as for the example 2 of a comparison, distributed combination of the polyester fiber was carried out at unsaturated-polyester-resin random, The conventional polymer composite Plastic solid with which distributed combination of the polyester fiber was carried out at random [the example 3 of a comparison] to liquefied silicone rubber, The polymeric-materials Plastic solid with which the

example 4 of a comparison consists only of an epoxy resin simple substance, the conventional polymer composite Plastic solid with which distributed combination of the polyester fiber was carried out at random [the example 5 of a comparison] to an epoxy resin, The example 6 of a comparison is the conventional polymer composite Plastic solid with which distributed combination of the polyester fiber was carried out at random to an unsaturated polyester resin, and, as for an anisotropy, neither is accepted in coefficient of linear expansion, a bending elastic modulus, tensile strength, and permeability.

[0103] On the other hand, the polymer composite Plastic solid of the example 1 of this invention - an example 6 By impressing a magnetic field to the macromolecule constituent with which polyester fiber was blended into polymeric materials After making polyester fiber magnetize and making orientation carry out in the fixed direction, it is the polymer composite Plastic solid which hardens or solidified the macromolecule constituent. It was admitted in the mechanical property shown with the bending elastic modulus and tensile strength of the axial parallel direction of polyester fiber, and an axial perpendicular direction, the thermal property shown with coefficient of linear expansion, and the optical property shown with permeability that the anisotropy was discovered.

[0104] (Example of modification) In addition, said operation gestalt can be changed as follows and can also be carried out.

- As functional plastic fiber, other plastic fiber and a metaphor should use a polyamide fiber, an aramid fiber, polybenzazole fiber, polyimide fiber, polyphenylene benzimidazole fiber, poly para-phenylene fiber, poly para-phenylene vinylene fiber, polyphenylene sulfide fiber, etc. Thereby, the highly efficient polymer composite Plastic solid in which the highly efficient nature of the plastic fiber of these various kinds was made to reflect and which has an anisotropy function can be acquired.

[0105] (Technical thought grasped) The technical thought grasped from said operation gestalt and the example of modification is indicated further.

[0106] (1) The manufacture approach of the polymer composite Plastic solid characterized by making it harden or solidify and fabricating a macromolecule constituent in a predetermined configuration after the plastic fiber which anisotropy diamagnetic susceptibility chia shows a forward value makes the macromolecule constituent blended into polymeric materials magnetize plastic fiber and makes orientation carry out in the fixed direction to it by impressing a magnetic field. While being able to make the orientation of the plastic fiber

by this carry out in the fixed direction to altitude by impressing a magnetic field as compared with the conventional process to which orientation of the plastic fiber can be carried out now in parallel along with line of magnetic force, and orientation of the fiber is carried out mechanically, the polymer composite Plastic solid which orientation is made to carry out in the fixed direction of arbitration, and has an anisotropy function can be acquired simply.

[0107] (2) The manufacture approach of a polymer composite Plastic solid given in the above (1) whose anisotropy diamagnetic susceptibility chia of plastic fiber is characterized by being 1x10 to eight or more. Since the orientation of the plastic fiber can be made by this to carry out in the fixed direction to altitude by impressing a magnetic field, while orientation control of fiber becomes easy, the polymer composite Plastic solid which orientation is made to carry out in the fixed direction of arbitration, and has an anisotropy function can be acquired still more simply.

[0108] (3) The above (1) characterized by plastic fiber being the plastic fiber which has a ring, or the manufacture approach of a polymer composite Plastic solid given in (2). While being able to carry out orientation to altitude by this using the magnetic field operation over the ring mentioned above so that a fiber axis may become parallel to line of magnetic force, the polymer composite Plastic solid which the orientation of the plastic fiber is made to carry out in the fixed direction of arbitration to altitude, and has an anisotropy function can be acquired still more simply.

[0109] (4) The manufacture approach of a polymer composite Plastic solid given in either of the above (1) to which fiber length of plastic fiber is characterized by being 10mm or less to (3). Thereby, while being able to make homogeneity distribute plastic fiber in polymeric materials, fabrication nature can be made good and orientation control of the plastic fiber in a macromolecule constituent becomes easy.

[0110] (5) The manufacture approach of a polymer composite Plastic solid given in either of the above (1) to which the loadings of plastic fiber are characterized by being 0.01 - 50 weight section to the polymeric-materials 100 weight section to (4). While orientation control of plastic fiber becomes easy by this, improvement in the practical functionality of the polymer composite Plastic solid acquired can be aimed at.

[0111] (6) The manufacture approach of a polymer composite Plastic solid given in either of the above (1) characterized by polymeric materials being at least one sort of polymeric materials chosen from the group which consists of

an epoxy resin, an unsaturated polyester resin, phenol resin, acrylic resin, urethane resin, polyimide resin, silicone resin, and liquid rubber to (5). In case plastic fiber is mixed, while orientation control of the plastic fiber which is the liquid of hypoviscosity, or is blended with polymeric materials since it can hypoviscosity-ize at the time of heating melting becomes easy by this, the temperature characteristics and electric dependability, such as thermal resistance, can be raised.

[0112] (7) The manufacture approach of a polymer composite Plastic solid given in either of the above (1) characterized by being the plastic fiber chosen from the group which plastic fiber becomes from polyester fiber, a polyamide fiber, an aramid fiber, Vinylon fiber, and polyolefine fiber to (6). Thereby, the highly efficient polymer composite Plastic solid in which the highly efficient nature of polyester fiber, a polyamide fiber, an aramid fiber, Vinylon fiber, or polyolefine fiber was made to reflect and which has an anisotropy function can be acquired easily.

[0113] (8) The polymer composite Plastic solid which the plastic fiber which anisotropy diamagnetic susceptibility chia shows a forward value is the polymer composite Plastic solid blended into polymeric materials, and is characterized by carrying out orientation of said plastic fiber in the fixed direction in polymeric materials.

[0114] (9) A polymer composite Plastic solid given in the above (8) whose anisotropy diamagnetic susceptibility chia of plastic fiber is characterized by being 1x10 to eight or more.

(10) The above (8) characterized by plastic fiber being the plastic fiber which has a ring, or a polymer composite Plastic solid given in (9).

[0115] (11) A polymer composite Plastic solid given in either of the above (8) to which fiber length of plastic fiber is characterized by being 10mm or less to (10).

(12) A polymer composite Plastic solid given in either of the above (8) to which the loadings of plastic fiber are characterized by being 0.01 - 50 weight section to the polymeric-materials 100 weight section to (11).

[0116] (13) A polymer composite Plastic solid given in either of the above (8) characterized by polymeric materials being at least one sort of polymeric materials chosen from the group which consists of an epoxy resin, an unsaturated polyester resin, phenol resin, acrylic resin, urethane resin, polyimide resin, silicone resin, and liquid rubber to (12).

[0117] (14) A polymer composite Plastic solid given in either of the above (8) characterized by being the plastic fiber chosen from the group which plastic

fiber becomes from polyester fiber, a polyamide fiber, an aramid fiber, Vinylon fiber, and polyolefine fiber to (13).

[0118]

[Effect of the Invention] As explained in full detail above, according to this invention, the highly efficient polymer composite Plastic solid which has anisotropy functions, such as thermal properties, such as mechanical properties, such as an elastic modulus and reinforcement, a coefficient of thermal expansion, and thermal conductivity, optical property, and an electrical property, can be offered by making the orientation of the polyester fiber which is blended into polymeric materials and is compound-ized carry out in the fixed direction of arbitration.

[0119] Moreover, after making the macromolecule constituent with which polyester fiber was blended into polymeric materials magnetize polyester fiber and making orientation carry out in the fixed direction to it by impressing a magnetic field, by making it harden or solidify and fabricating a macromolecule constituent in a predetermined configuration, the orientation of the polyester fiber can be made to be able to carry out in the direction of arbitration to altitude, and the manufacture approach which can be manufactured can be easily offered for the highly efficient polymer composite Plastic solid which has an anisotropy function.

[Translation done.]